HEPNET and HEP Computing

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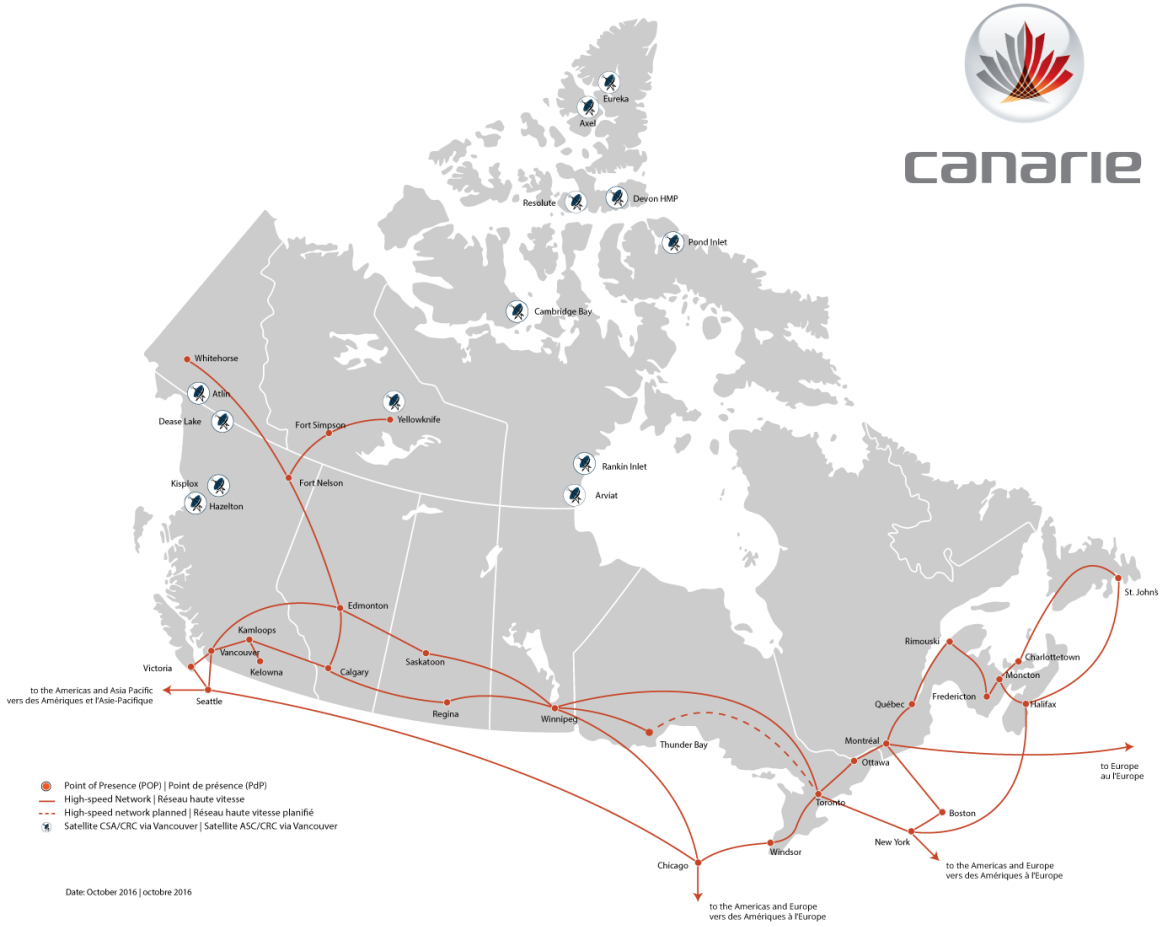
HEPNET/Canada

- HEPnet/Canada is responsible for national and international network connectivity for the subatomic physics community
  - Established in 1990
  - Funded with an NSERC MRS award until March 2020

- HEPnet organization:
  - Directors : *Ogg 1990-1994; Karlen 1994-2004; and Sobie 2004-present*
  - Technical Manager: *Gable (2006-2015) and Seuster (2016-present)*
  - IPP Advisory Committee: *Tafirout, Warburton, Virtue*

- Activities
  - Connecting Canadian sites to the HEP networks
  - Network monitoring and trouble shooting
  - Collaborating with Canadian and international network organizations
  - International representation of the Canadian community (e.g. WLCG, ICFA)
  - Network R&D projects

Canada's research network



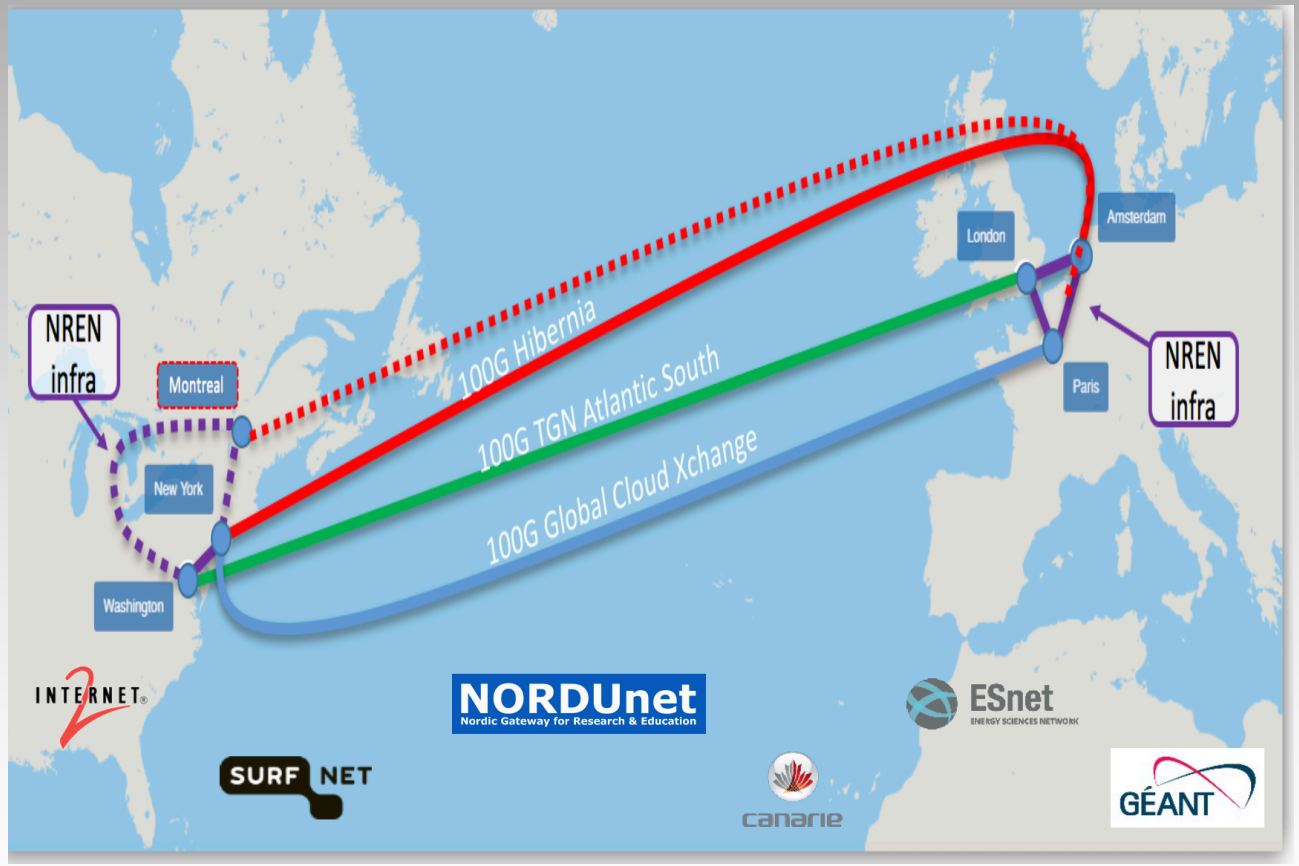
National 100G backbone
(with 100G backup)

International peering
(Seattle, Chicago, NYC, Montreal)

Provincial organizations provide links to the universities and laboratories

Dedicated HEP networks

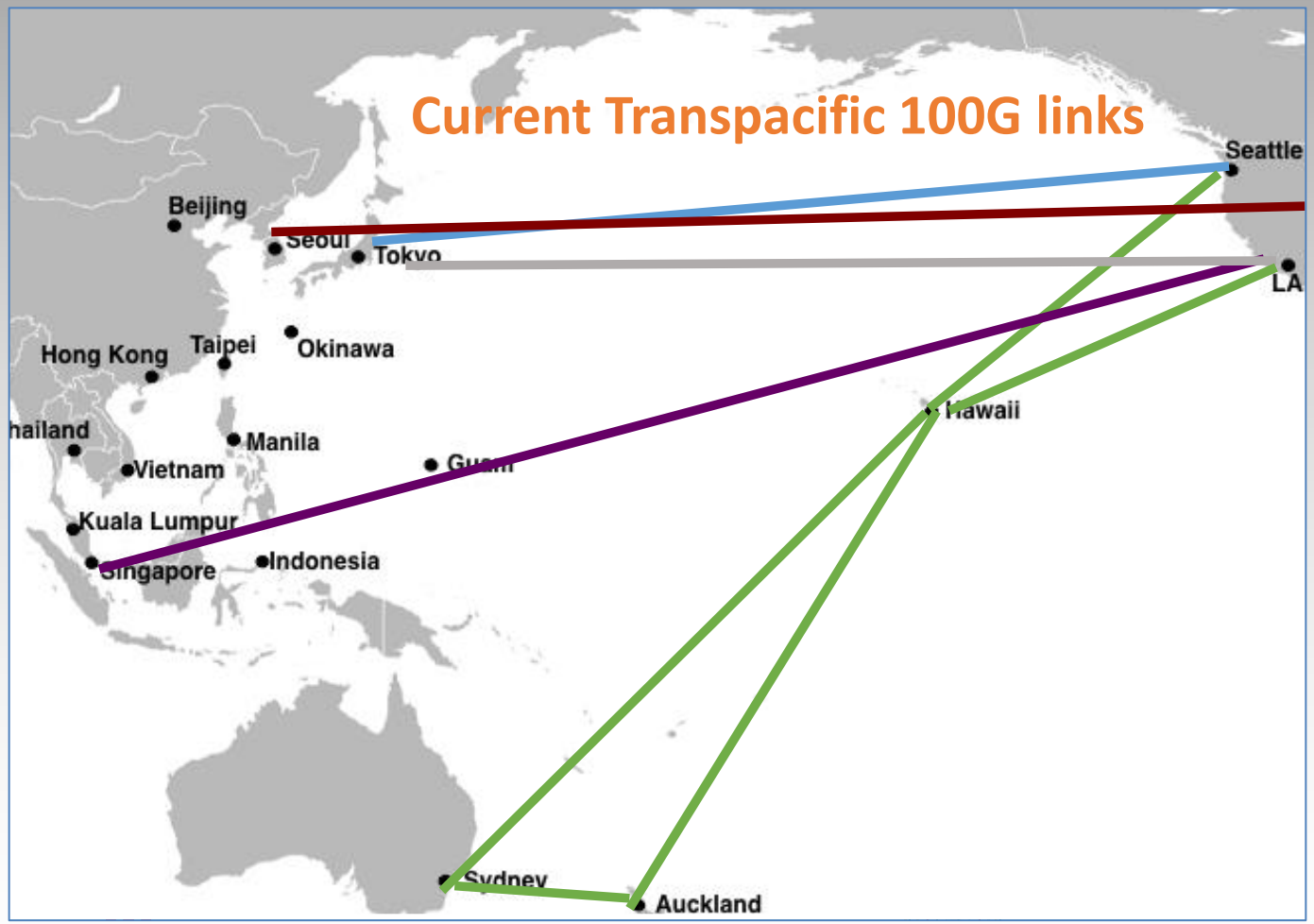
Transatlantic network – ANA 300



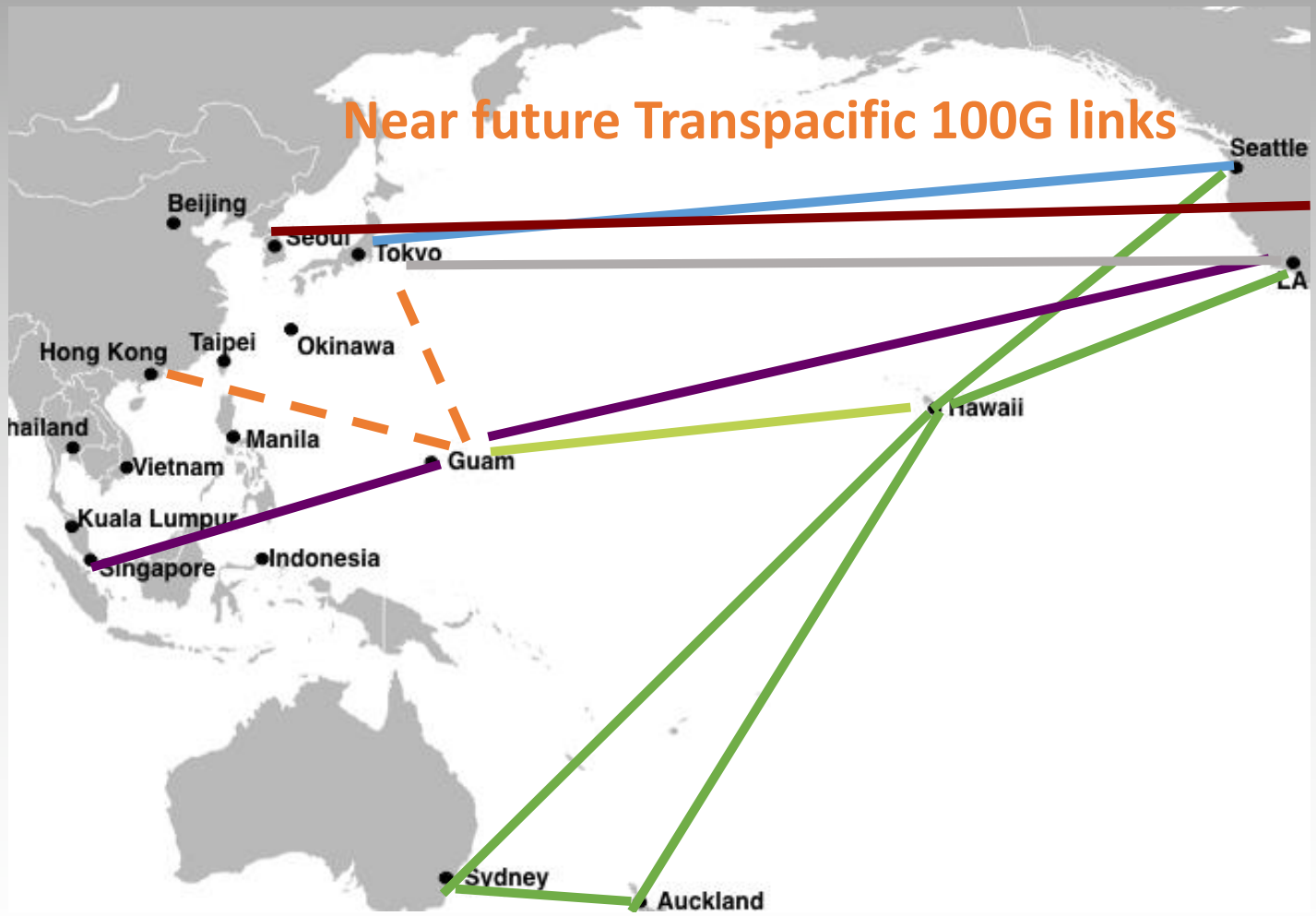
Montreal-Amsterdam link used for the LHCOPN traffic

LHCONE traffic may move soon

Transpacific network

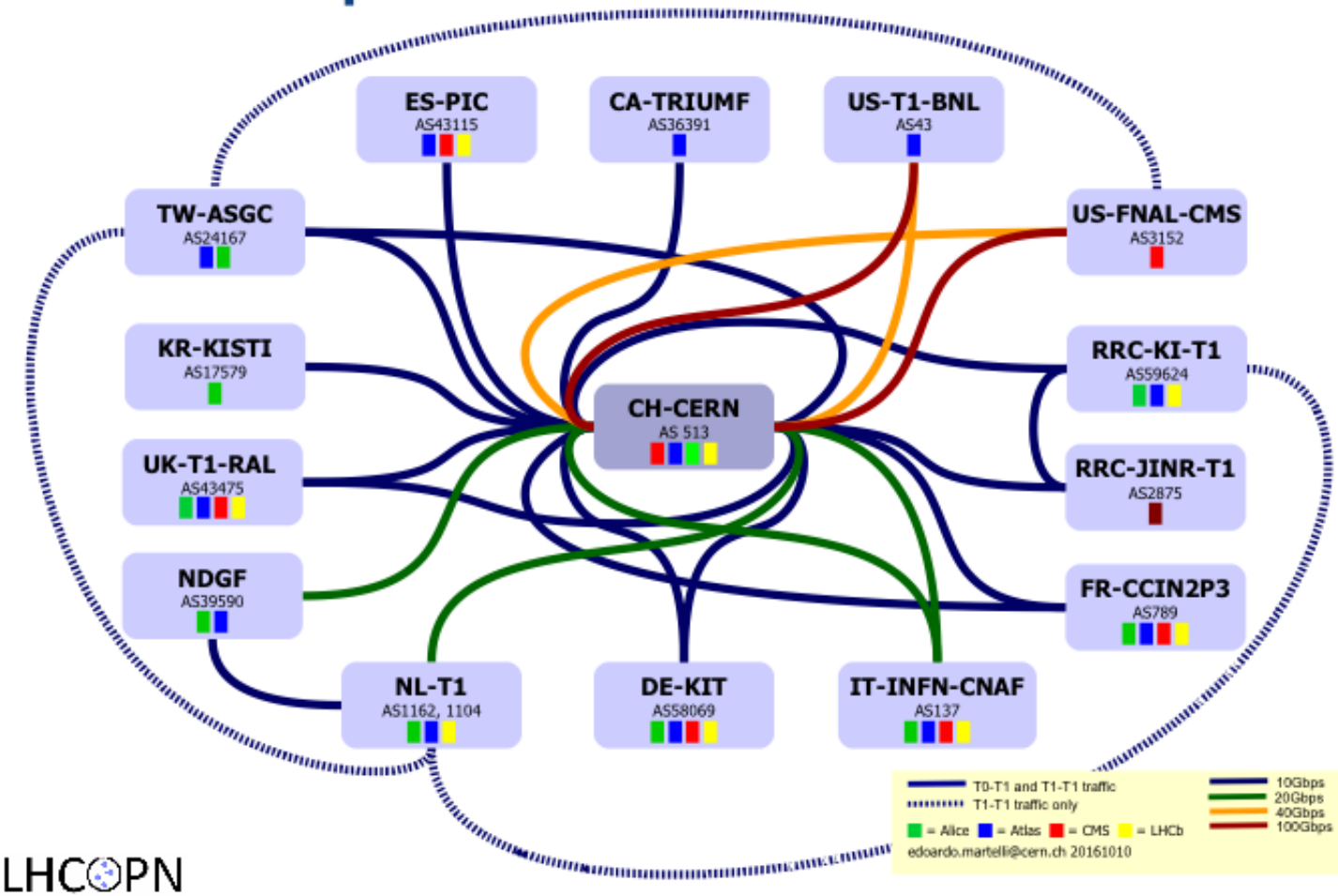


Future transpacific network



LHCOPN map

Dedicated network for LHC Tier-0 to Tier-1 traffic



LHCOPN

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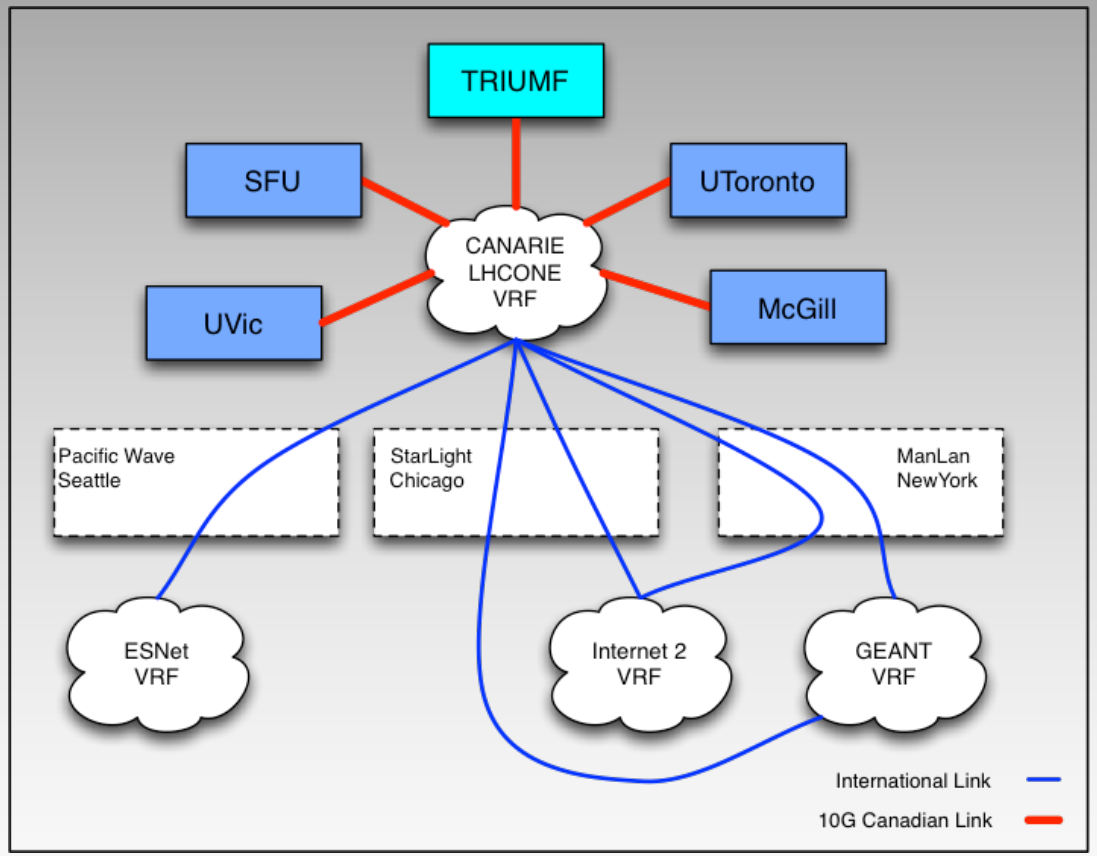
LHCONE

(WLCG private routed network)



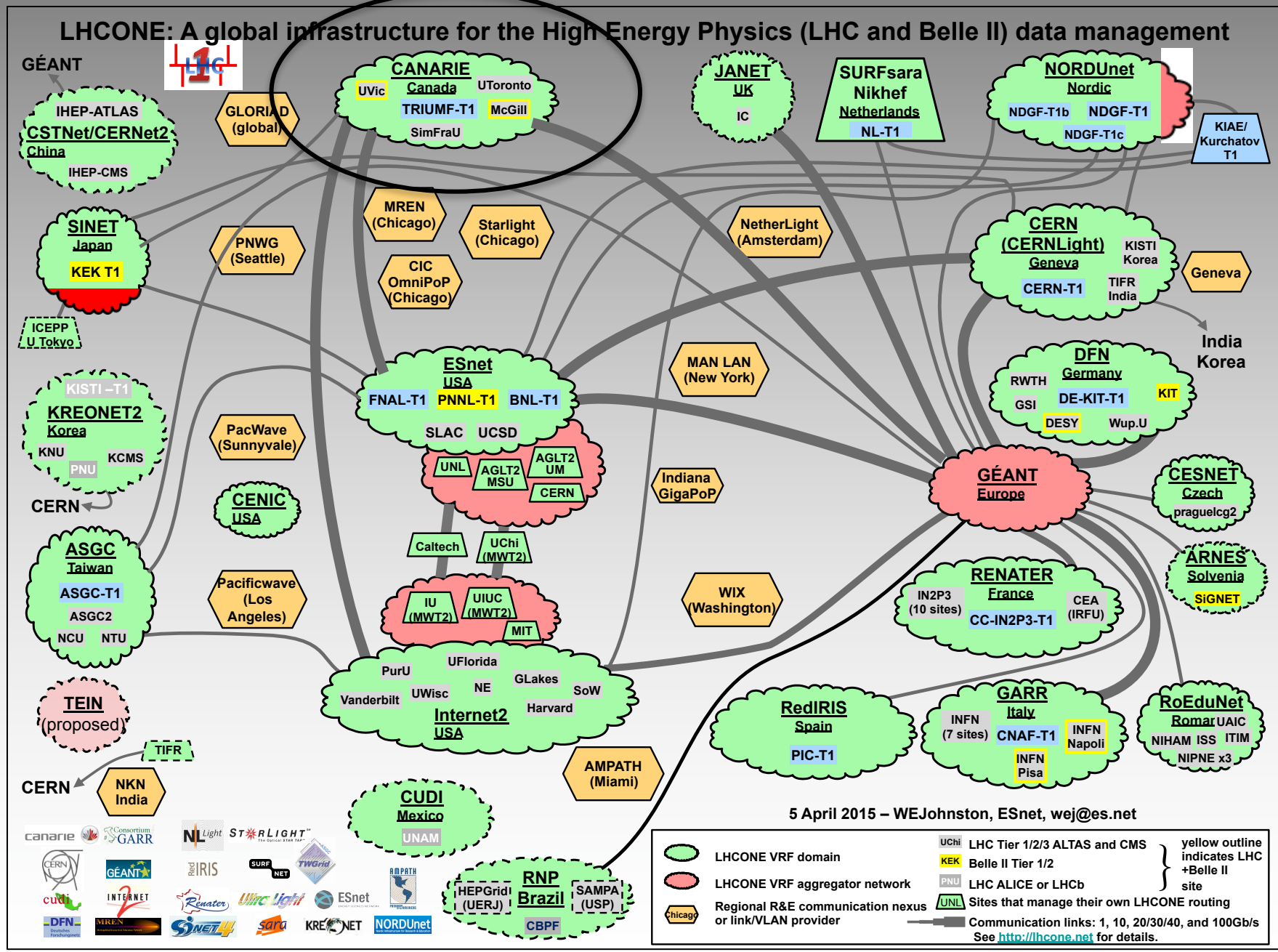
10-100G virtual private network linking the T0, T1s and T2s

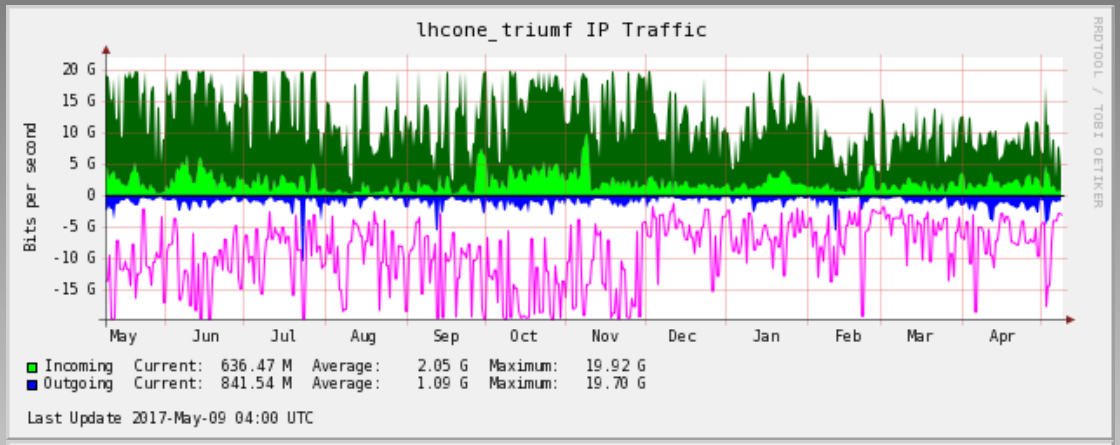
Private network for LHC and HEP

Other approved HEP experiments include Belle II

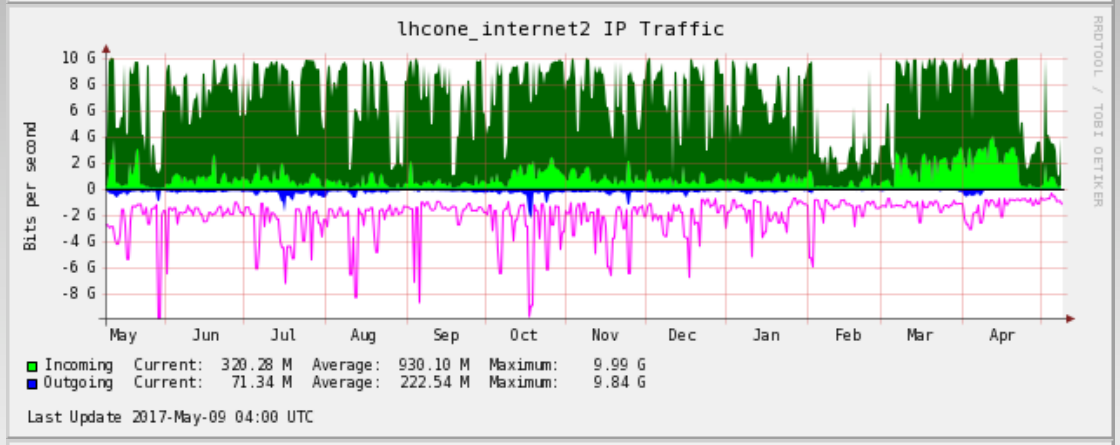
Not shown is the new connection to GEANT in Montreal

Need to add Waterloo to LHCONE

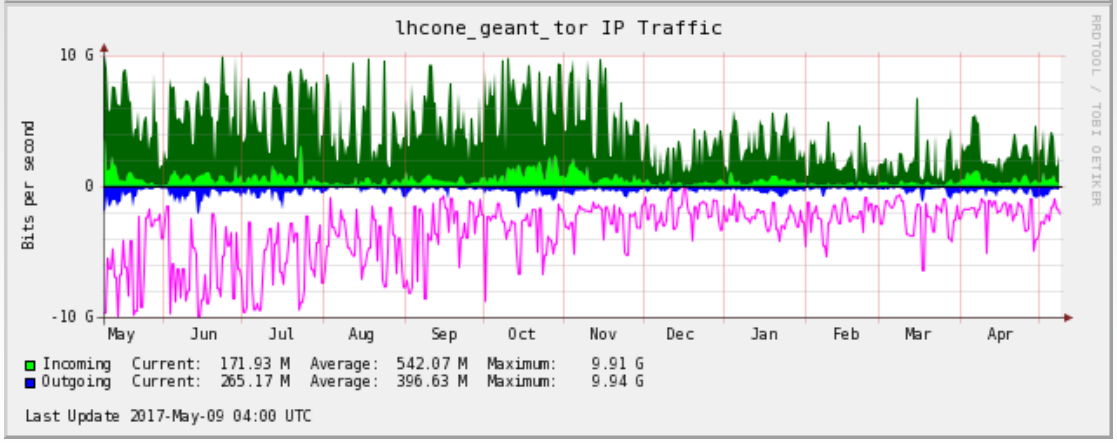

LHCONE: A global infrastructure for the High Energy Physics (LHC and Belle II) data management
GÉANT
IHEP-ATLAS
CSTNet/CERNet2
China
IHEP-CMS
GLORIAD (global)
CANARIE
Canada
UVic
UToronto
TRIUMF-T1
McGill
SimFraU
JANET
UK
IC
SURFsara
Nikhef
Netherlands
NL-T1
NORDUnet
Nordic
NDGF-T1b
NDGF-T1
NDGF-T1c
KIAE/
Kurchatov
T1
SINET
Japan
KEK T1
ICEPP
U Tokyo
PNWG
(Seattle)
MREN
(Chicago)
Starlight
(Chicago)
CIC
OmniPoP
(Chicago)
NetherLight
(Amsterdam)
CERN
(CERNLight)
Geneva
CERN-T1
KISTI
Korea
TIFR
India
Geneva
India
Korea
KISTI –T1
KREONET2
Korea
KNU
PNU
KCMS
CERN
ESnet
USA
FNAL-T1
PNNL-T1
BNL-T1
SLAC
UCSD
MAN LAN
(New York)
DFN
Germany
RWTH
GSI
DE-KIT-T1
KIT
DESY
Wup.U
PacWave
(Sunnyvale)
UNL
AGLT2
MSU
AGLT2
UM
CERN
Indiana
GigaPoP
GÉANT
Europe
CESNET
Czech
praguelcg2
CENIC
USA
ASGC
Taiwan
ASGC-T1
ASGC2
NCU
NTU
Caltech
UChi
(MWT2)
ARNES
Solvenia
SiGNET
Pacificwave
(Los
Angeles)
IU
(MWT2)
UIUC
(MWT2)
MIT
WIX
(Washington)
RENATER
France
IN2P3
(10 sites)
CC-IN2P3-T1
CEA
(IRFU)
PurU
UFlorida
GLakes
NE
SoW
Vanderbilt
UWisc
Harvard
Internet2
USA
TEIN
(proposed)
TIFR
CERN
NKN
India
RedIRIS
Spain
PIC-T1
GARR
Italy
INFN
(7 sites)
CNAF-T1
INFN
Napoli
INFN
Pisa
RoEduNet
Romar
UAIC
NIHAM
ISS
ITIM
NIPNE x3
AMPATH
(Miami)
CUDI
Mexico
UNAM
RNP
Brazil
HEPGrid
(UERJ)
SAMPA
(USP)
CBPF
5 April 2015 – WEJohnston, ESnet, wej@es.net
LHCONE VRF domain
LHCONE VRF aggregator network
Chicago
Regional R&E communication nexus or link/VLAN provider
UChi
LHC Tier 1/2/3 ALTAS and CMS
KEK
Belle II Tier 1/2
PNL
LHC ALICE or LHCb
UNL
Sites that manage their own LHCONE routing
yellow outline indicates LHC +Belle II site
Communication links: 1, 10, 20/30/40, and 100Gb/s
See http://lhcone.net for details.



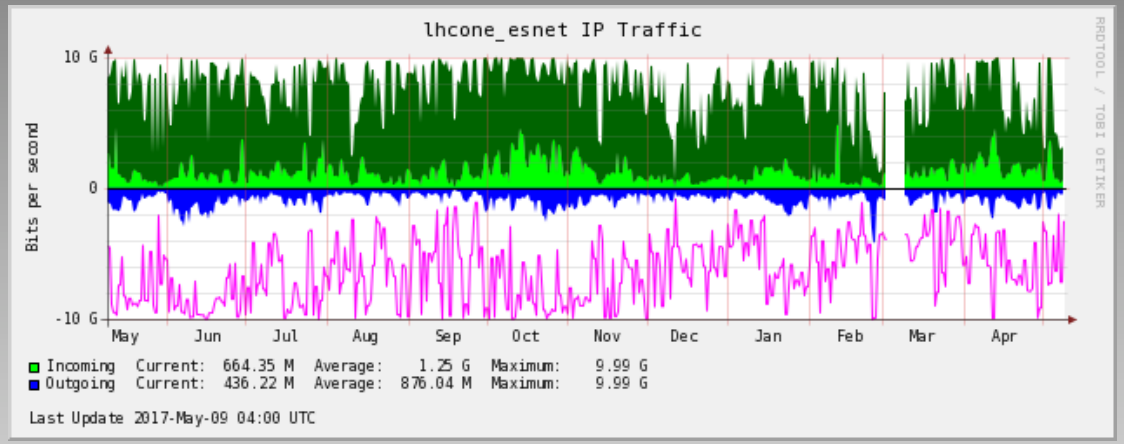
TRIUMF



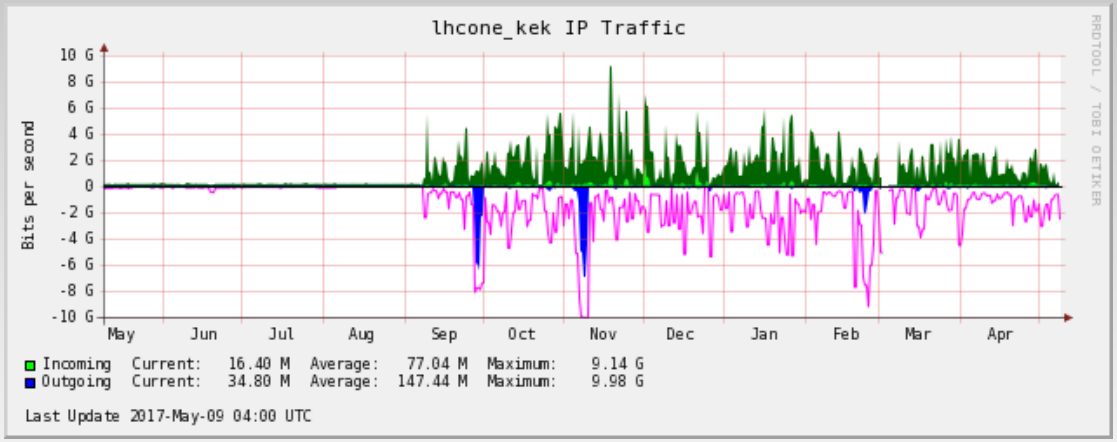
Canadian traffic to Internet2



Canadian traffic to GEANT
(1 of 3 links)

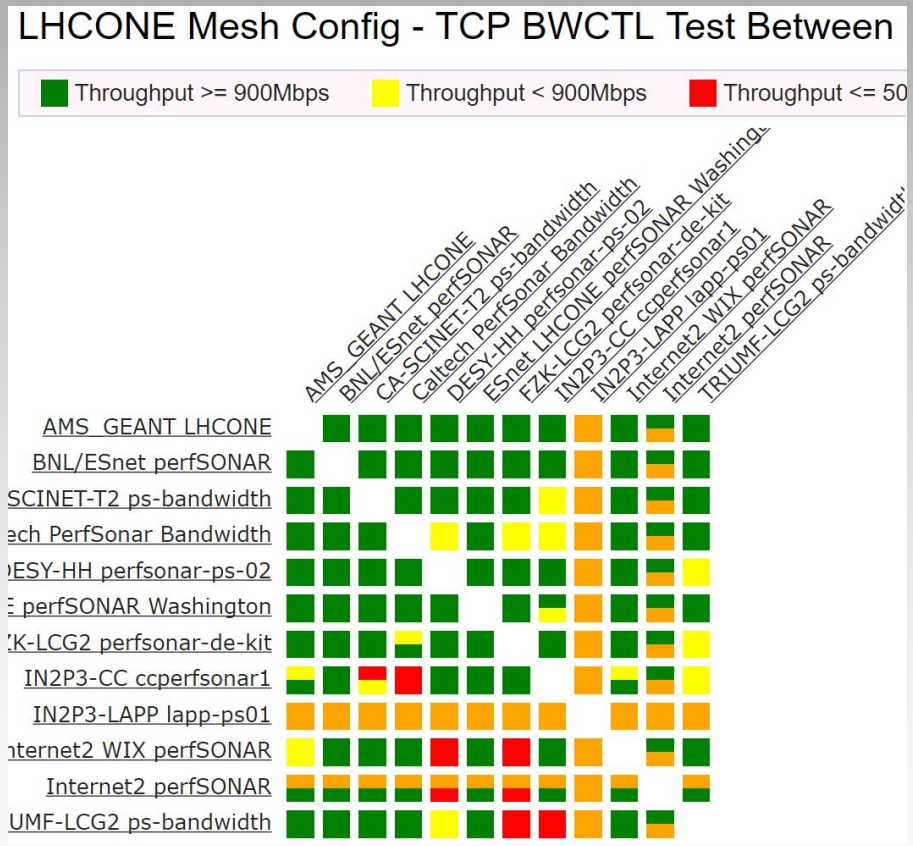


ESNet via Seattle
(includes traffic to Asia)



Canadian traffic to KEK

Network monitoring



HEPNET operates a set of ”perfSonar” network monitoring systems

The information is fed back to a central monitoring system.

Used for network status but also being investigated for job scheduling

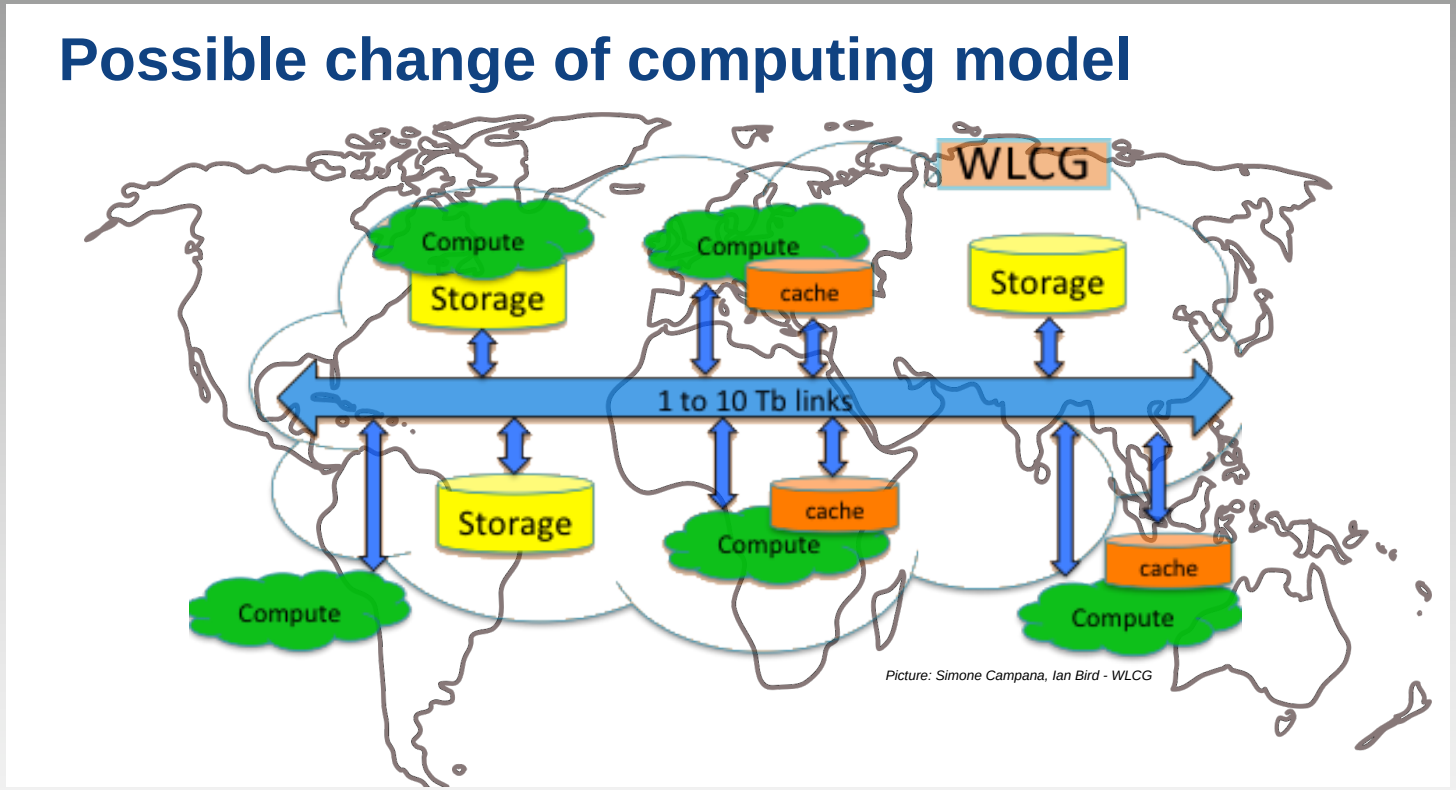
HEPNET has ordered 3 new systems in April 2017

Changing landscape of computing

- ATLAS Tier-1 centre in process of moving from TRIUMF to SFU
  - CFI proposal decision due in June
  - Basic network infrastructure in place (LHCONE and LHCOPN)
  - https://indico.cern.ch/event/578986/contributions/2579134/attachments/1456907/2248613/TRIUMF_T1_GDB.pdf
- ATLAS Tier-2 centres at SFU and Waterloo
  - ATLAS cloud production (CERN, Compute Canada, commercial, private clouds)
- Belle II computing almost entirely cloud based
  - Use new technologies – cloud and object storage
  - Need for Tier-1 (cloud) resources in 2020 (separate CFI application for T1?)
- IPP White Computer highlighted wide range of computing requirements
  - http://www.ipp.ca/pdfs/SAP-WhitePaper-Submitted.pdf

High-speed networks opening new options for computing

LHCONE meeting at BNL in April 2017



CFI Cyberinfrastructure Project – distributed data and cloud for HEP

Summary

- Active period with many changes and new projects
- Other activities
  - Established peering with commercial cloud providers (e.g. Amazon EC2, Microsoft Azure)
  - IPV6 network address space
  - Refresh of network monitoring (perfSonar) hardware
  - Network R&D efforts – cloud network tunnels
  - Terabit/second networks in 5 years?
- Networks are enabling new ways of using our resources
  - Future will see continued decoupling of compute and storage
  - Intelligent use of network infrastructure